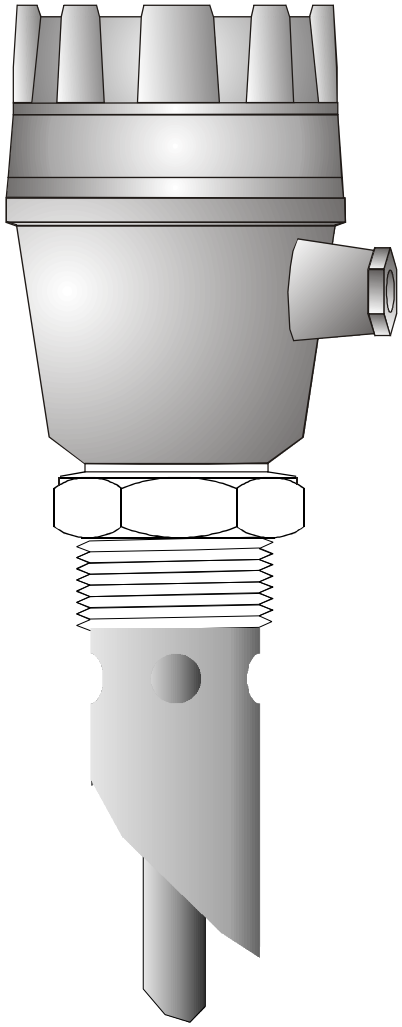
User's Manual

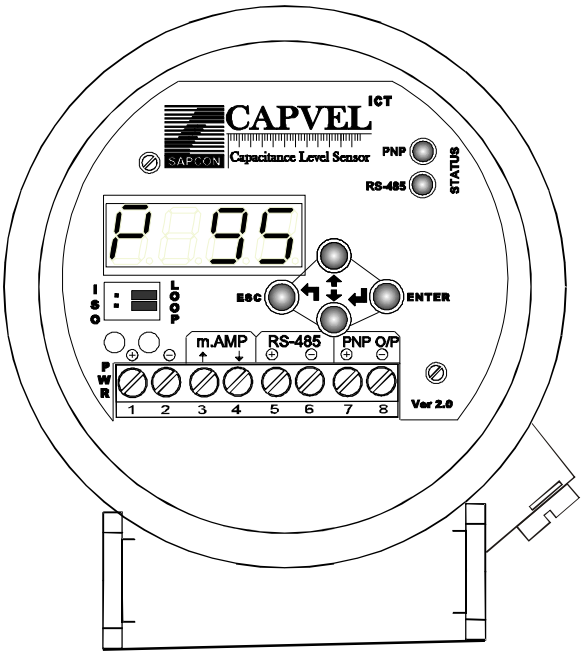
SAPCON

Capacitance Level Indicator, Controller and Transmitter

CAPVEL ICT ver 2.6

Updated on 05 March 2013





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Operating Principle

CAPVEL is composed of specially developed Capacitance Change Gauging circuit. It uses fast RISC based processor to perform all the complicated jobs of evaluating the Level out of the capacitance. This capacitance is formed by the sense Rod and the metallic container wall. Where containers are non-metallic or not-uniformally wide or having turbulent fluid, a metallic stilling well is provided. The amount of capacitance is proportional to the level of material between the sense rod and metallic wall of stilling tube or container.

System Description

Referring to the " Various Parts" page, CAPVEL is composed of cast aluminum housing, supplied with suitable mounting arrangement viz. NPT, BSP or Flanges and Two metallic cable entries. An External Earthing/Grounding Terminal is also provided. The sensing rod which is mostly Teflon coated. This sensing rod can be replaced by flexible probe for some applications. The stilling tube is also provided for turbulent fluids, irregular width tanks, non metallic tanks or for fluids with low dielectric (e.g. diesel).

Opening the threaded aluminum cover, an electronic insert could be found. This is the electronic unit which converts the level into 4-20mA signal depending on the calibration. The status LED is a bicolor LED that blinks alternately in Red and Green to indicate instrument is in process of converting the level to 4-20mA signal. Two DIP switches are provided to calibrate the 4mA and 20mA points. The calibration is easy and a complete procedure is given in "Calibration" page. The two wires connected at the back are pre-connected sensor wires and should not be disturbed. Also while calibration try to keep hands away from the wires of terminal # 6 and 7.

Now referring to the "Connection Diagram" page, CAPVEL Can be wired in two possible combinations. Preferred one is galvanically isolated, 4-wire, combination. Where only one source of power is available, 3-wire, non-isolated combination can also be used. The converted level signal can be sensed using a 4-20mA indicator or PLC 4-20mA input or Multi-meter in 40mA range or any-other device that takes 4-20mA signal as input.

Mechanical Specs

Housing	:	Cast aluminium weather & Flame proof suitable for mounting in hazardous area Gas Group IIA & IIB as per IS-2148
Mounting	:	Integral with sense rod or probe with SS / MS(plated) Screw - 1"/1-1/2" BSP/NPT (M) Flanged - (As per your order)
Cable Entry	:	2 X ½" / 3/4" BSP / NPT, Brass
Gland type	:	Double Compression Gland
Sensing	:	Fully or Partially Teflon Coated Rod, Flexible Probe SS 316
Stilling Tube	:	Pipe, G I / S S
Overall Dimensions	:	Please refer enclosed probe drawing

Electrical Specs

Mains	:	Capvel-BT : 9v to 55v DC Capvrl-ICT : 9v to 30v DC
Power Consumption	:	Capvel- BT : max 0.5 watt @12V Capvel-ICT : max 1 watt @12V

Measurement Specs

Measurement Span	:	15 to 3000pf above Zero
Response Time	:	0.5 to 5 secs. (Adjustable)
Accuracy	:	+/- 1 % FSL or better *
Electronics Ambient Temp.		0 C. to + 60 C.
Fail Safe Feature		Reverse Calibratable (Low Level: 20mA, High Level: 4mA)

Capvel-BT Features

User Interface	:	2 dip switches + 2 LED
Output - 1	:	4-20mA, Galvanically Isolated.
Output - 2	:	Rs485 Digital Data

Capvel-ICT Features

User Interface	:	4 Digit Display with 4 Keys + 2 LEDs
Output - 1	:	4-20mA, Galvanically Isolated.
Output - 2	:	Rs485 Digital Data
Output - 3	:	Controling Devices connectd with External Relay

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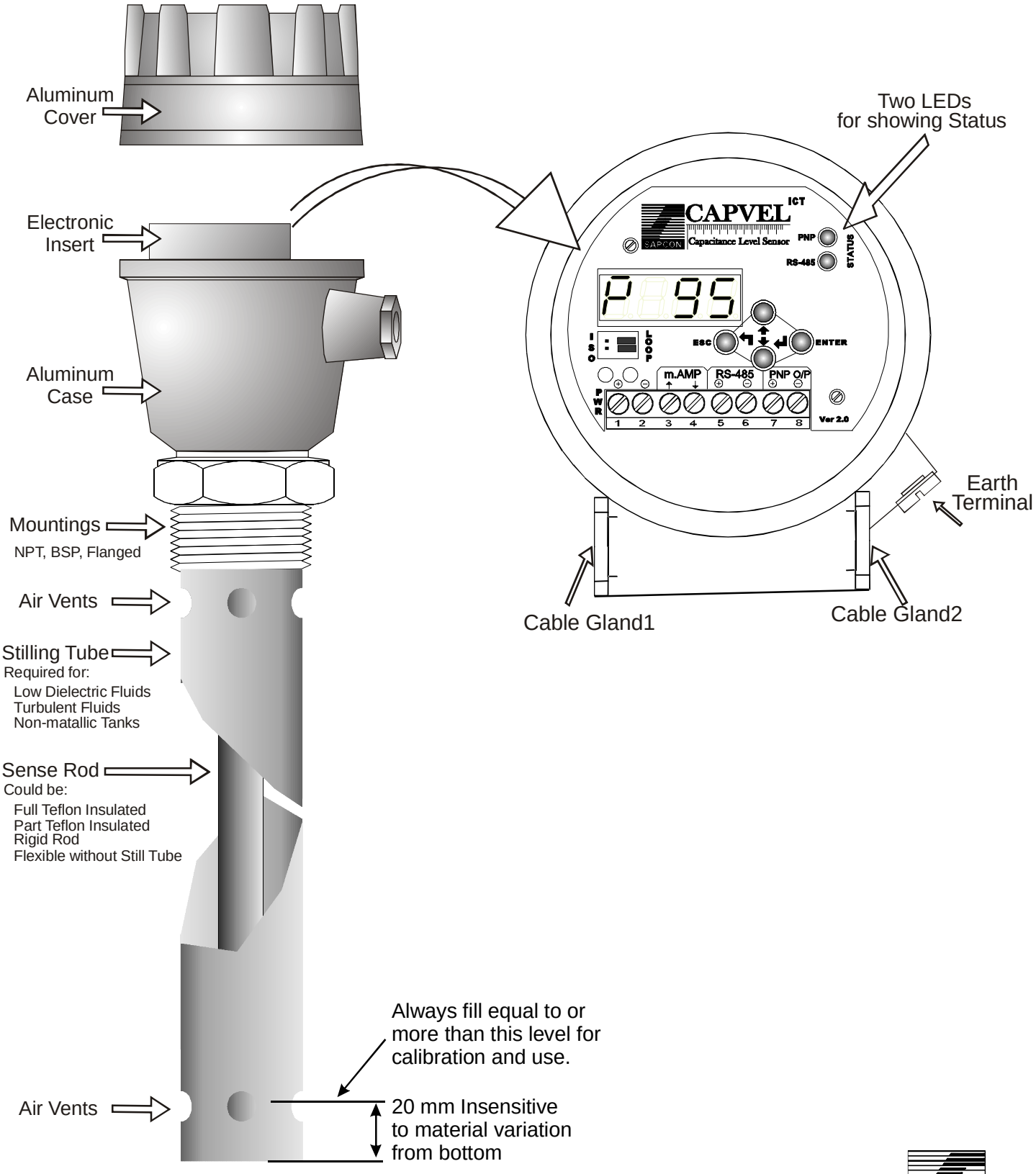
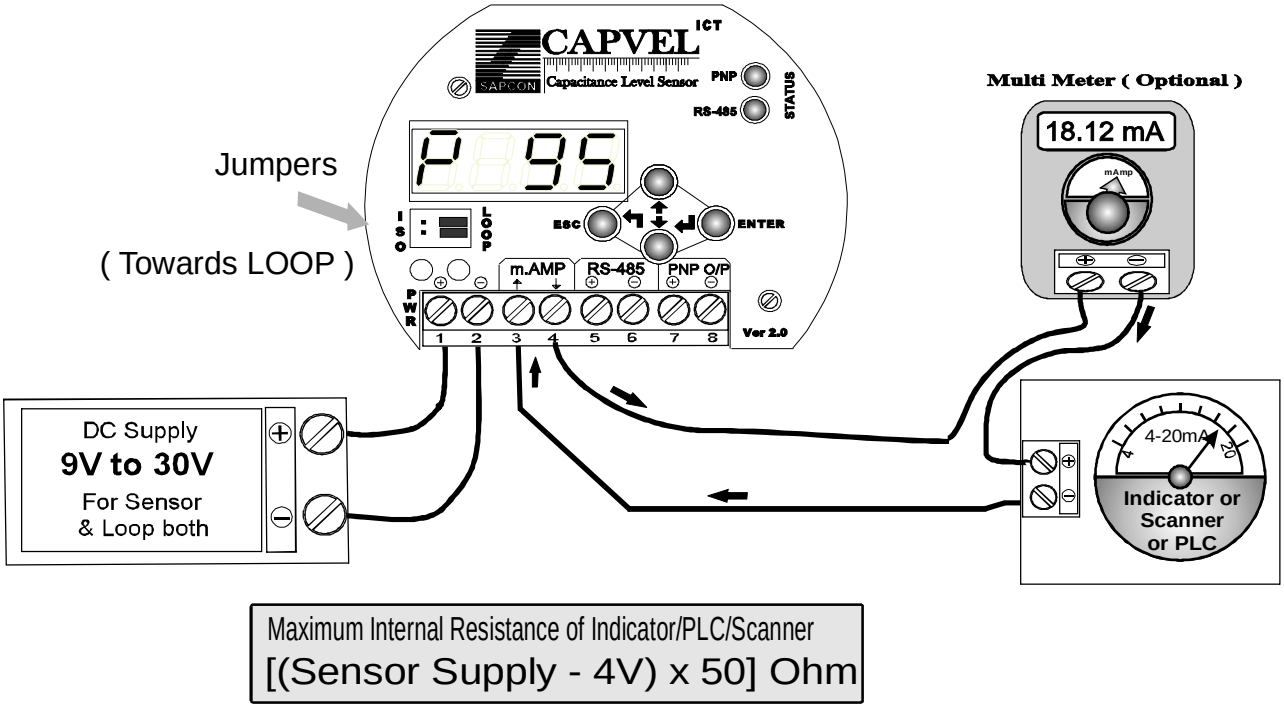
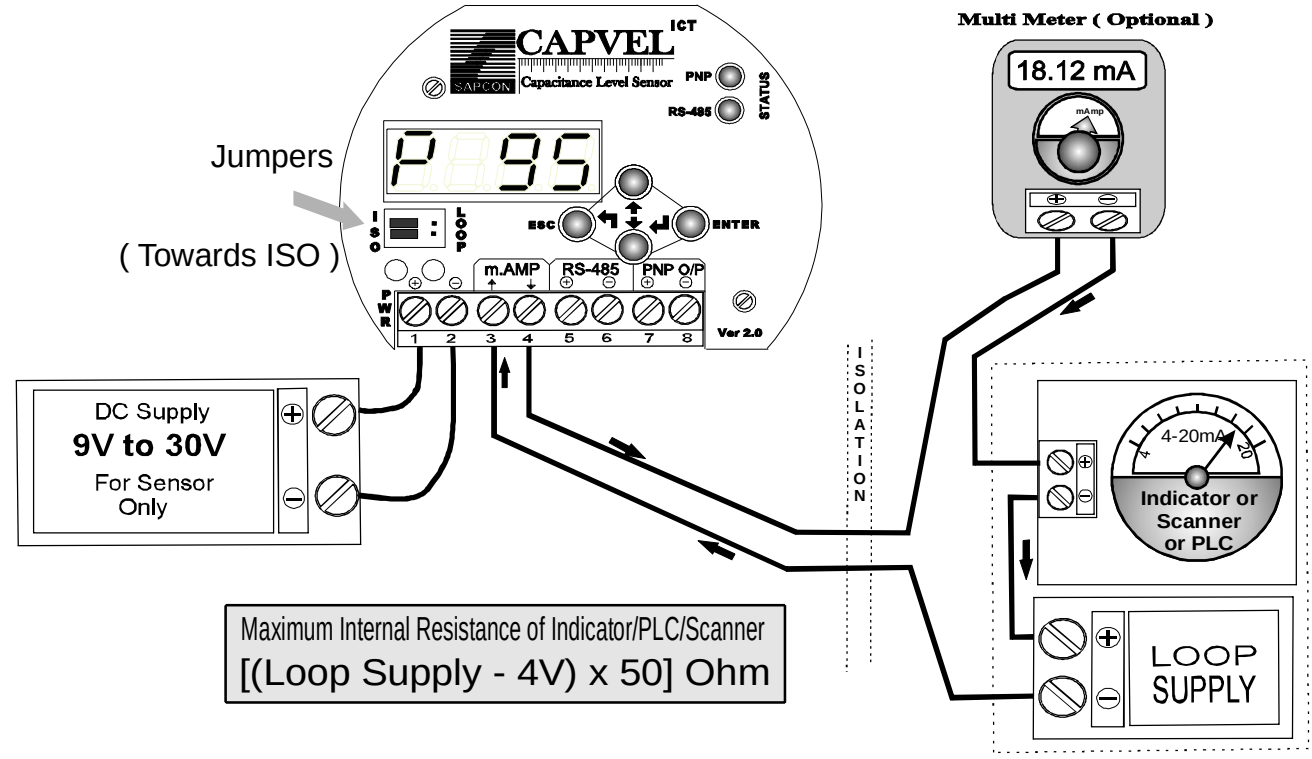

Aluminum Cover
Electronic Insert
Aluminum Case
Mountings
NPT, BSP, Flanged
Air Vents
Stilling Tube
Required for:
Low Dielectric Fluids
Turbulent Fluids
Non-matallic Tanks
Sense Rod
Could be:
Full Teflon Insulated
Part Teflon Insulated
Rigid Rod
Flexible without Still Tube
Air Vents
Always fill equal to or more than this level for calibration and use.
20 mm Insensitive to material variation from bottom
Two LEDs for showing Status
CAPVEL ICT
Capacitance Level Sensor
PNP
RS-485
STATUS
ESC
ENTER
m.AMP
RS-485
PNP O/P
Ver 2.0
1 2 3 4 5 6 7 8
Earth Terminal
Cable Gland1
Cable Gland2



Maximum Internal Resistance of Indicator/PLC/Scanner
[(Sensor Supply - 4V) x 50] Ohm

3-wire Single Supply Operation



Maximum Internal Resistance of Indicator/PLC/Scanner
[(Loop Supply - 4V) x 50] Ohm

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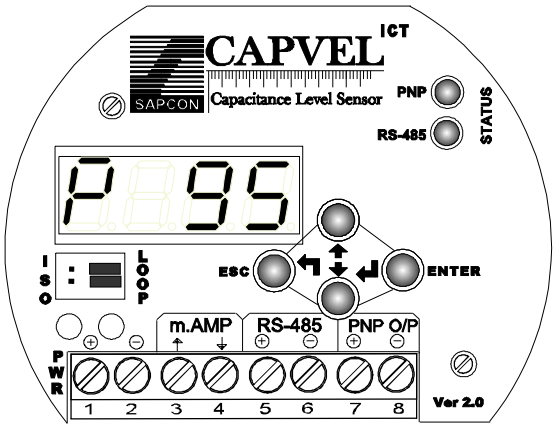
4-wire Dual Supply Operation (Galvanic Isolated)



We need to calibrate the sensor at any two levels before taking any reading from it.

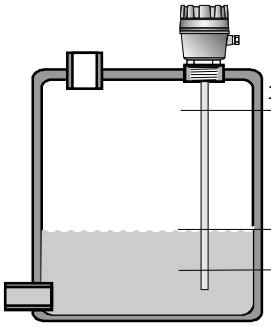
In Calibration Process we "Tell" the sensor to remember these two levels to use as reference in all calculations

Factory setting is :-
Low SCAL=0% and High SCAL = 100%.

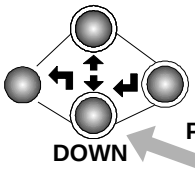
We may adjust these levels any time by "SCAL" Menu

Procedure of Calibration

Calibrating Lower Level



1 When material is at 0% or 4mA level.

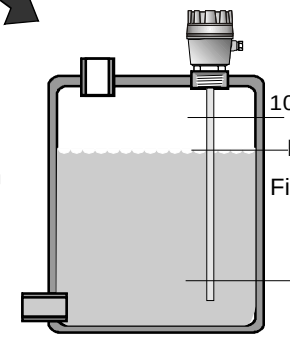


2

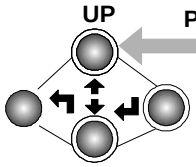
3 **Wait for around 5 Seconds**

Lower Calibration has done !

Calibrating HIGH Level



1



2

3 **Wait for around 5 Seconds**

Upper Calibration has done !

Now the Sensor is in RUN MODE again !

We can Calibrate 4mA and 20mA in any order according to our choice.
The order of empty-fill or fill-empty is immaterial.

	MENU	SUB MENU	CHANGE	Description	Remark
HOME	rLdr Relay Drive	r. FS	FS. H < > FS. L	**Fail Safe Selection** FS.H / FS.L : Fail Safe High/Low	
		r.oPt	o.Ind< >o.PUM	**Control Action Selection** Ind : Individual, PUM : Pump	
		r. SP	S.000 < > S.100	**Set point** Only in Individual Controlling	
		r.SPH	h.001 < > h.100	**Higher Set point** Only in Pump Controlling	SPH must be higher than SPL
		r.SPL	L.000 < > L.099	**Lower Set point** Only in Pump Controlling	
		r. Cd	C.000 < > C.100	**Cover Delay** in Seconds	
		r.Ud	U.000 < > U.100	**Un Cover Delay** in Seconds	
	SCAL Scal Factor	SC.-H	H.020< >H.100	**Higher SCALE LEVEL**	SCAL-HIGH must be 20 % or more Higher than SCAL-LOW
		SC.-L	L.000< >L.080	**Lower SCALE LEVEL**	
	dISP Display	d.PER < >d.AmP		**Display Options** PER : Percentage, AmP : mAmp	
	trbu Turbulence	t.001 < > t.010		**Turbulence Immunity**	
	vts Vehicle Mode	1 = ON 0 = OFF		**Immunity to vehicle generated fluctuations**	Only usefully in Vehicle tracking Systems
	Com Comm-unication Settings	c. ID	Id.00 < > id.99	**Communication ID** of Sensor on RS485 Network	
		c.bAU	b.00.3 < > b. 38.4	**Communication Baud Rate** 9.6 x 1000 = 9600bps and so on	
		c.Flo	F.CMd< >F.AUt	**Flow Control** CMD: Send data when Commanded AUt : Send Data Automatically	
		c.dur	d.001 < > d.250	**Auto Data Sending Duration** in Seconds	(Flow : AUt)
	othr	o.LEN	LE0.0 < > LE9.9	**Probe Length** in meters	Only for optimization
		o.PRF	PR.1 < > PRF.9	**Profile**	
	InFo	i.SEr	12345678	**Serial No**	Factory Sated & Read Only
		i.dAt	12345678	**Mfd. Date** in DD-MM-YY format	

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ERROR DISPLAY & REMEADY

CODE	ERROR DISPLAY	ERROR Description	Troubleshooting	Remark
1	PrOP	Probes are OPEN Circuited	Check the probes with multi meter	
2	PrSC	Probes are SHORT Circuited	Check the probes with multi meter	
3	ECAL	Calibration Error	Calibration is wrong, Please Recalibrate correctly	
4	PrHI	Over Capacitance	Tank & probe Dimensions are not matched	
5	PrLO	Under Capacitance	Tank & probe Dimensions are not matched	
6	RFOP	Internal Reference got open circuited	Internal fault in sensor	
7	RFSC	Internal Reference got short circuited	Internal fault in sensor	
8	RFHI	Internal Reference saturated	Internal fault in sensor	
9	RFLO	Internal Reference negligible	Internal fault in sensor	
10	OSC	Oscillations Stopped	Internal fault in sensor	

RS485 Serial Commands for Communication with CAPVEL

Port Settings

Baud Rate = **9600**, Flow Control = **NONE,** Data bits / Parity / Stop bit = **8 / N / 1** * may be changed on demand

Asking Percentage Level Information

Ser	Command Description	Command to be send to Sensor	Expected Response from Instrument	Explanation
1.	Level would be calculated by dividing incoming five digit number with 10 Please note that :- • Application software must have to take care of any possible errors during turn-on or off durations, change in nature of service material etc.	**<A,PER?>** **or** **<B,PER?>** **or** **<a,PER?>** **or** **<z,PER?>** **or** **<Z,PER?>**	**<A,PER=01000,H>** **<B,PER=01000,N>** **<a,PER=00625,N>** **<z,PER=00000,N>** **<Z,PER=00000,L>**	100.0% (OVER) 100.0% (NORMAL) 62.5% (NORMAL) 0 % (NORMAL) 0 % (LOW)

Configuring & Asking Sensor ID on Network **(Factory Setted ID is :- A)**

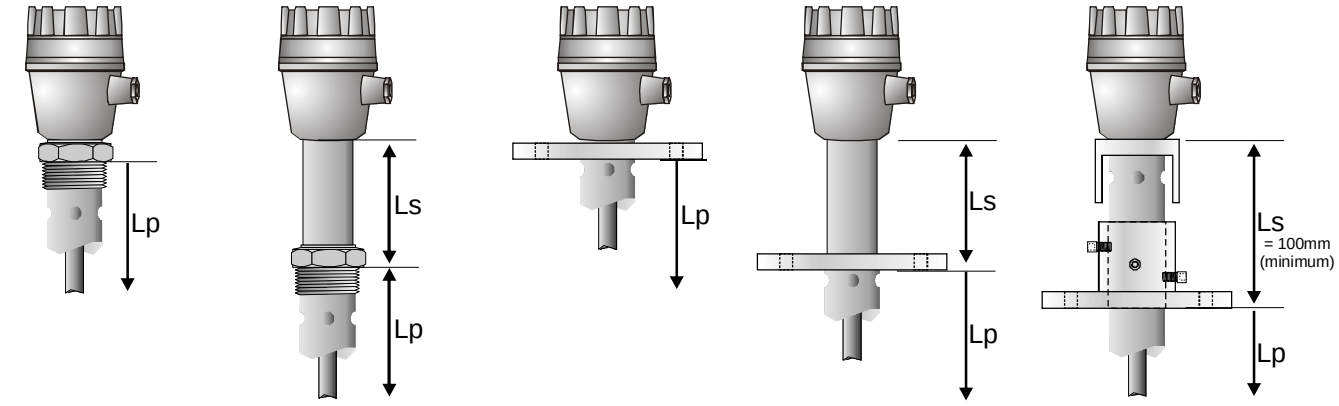
Ser	Command Description	Command to be send to Sensor	Expected Response from Instrument	Explanation
1.	Asking single letter ID of Instrument on RS-485 Network	<*,ID?>	<A,ID=A>	Instrument is telling it's ID
2.	Setting single letter ID of Instrument on RS-485 Network Ex. setting id as :- 'A' (Capital A)	<*,ID=A>	<A,OK>	ID is taken by Instrument and this is the acknowledgement from it

CAPVEL- ICT

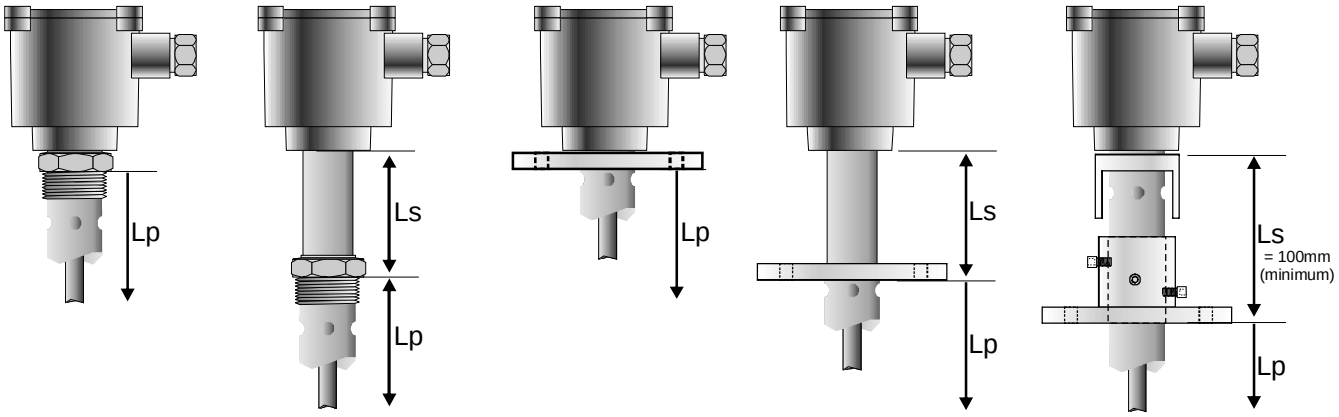
: Drawings

Screw	Screw with Stand-off	Flange	Flange with Stand-off	Adjustable Flange

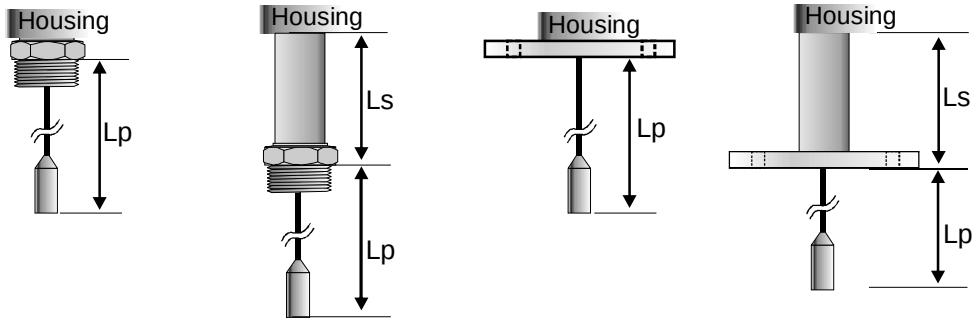
Weather Proof Enclosure



Flame Proof - (Gas Group -IIA & IIB : IS-2148)



Rope probes with weather-proof / flame-proof enclosure indicated above



NPT: 1" / 1¼" / 1½"
BSP: ¾" / 1" / 1½"

ASA: 1½" / 2" / 3" / 4"
ANSI: 1½" / 2" / 3" / 4"

Lp = Probe Length, Ls = standoff length

Refer your order & Sapcon challan specifations for dimensions and other technical details of Screw, Probe length, Stand-off length, Flange, Probe type (rope/rod with or without still-tube),

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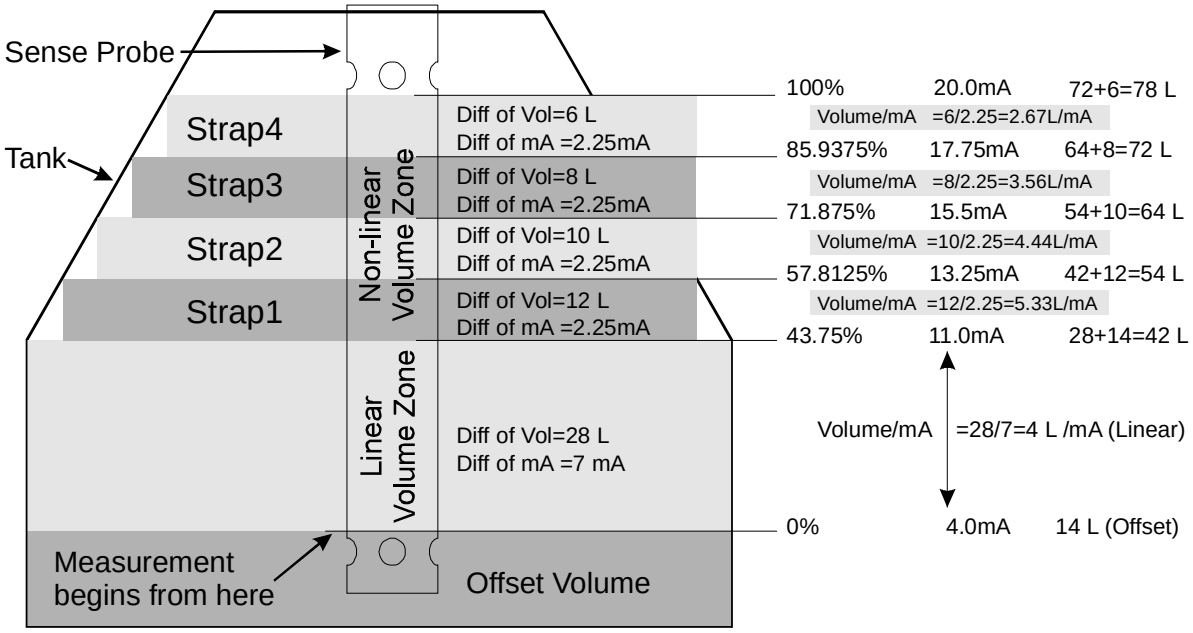
Method of approximating volume of fluid in irregular shape tanks
for PLC/SCADA using CAPVEL 4-20mA output



Change of volume per mA is linear from bottom to mid level, while it is non-linear at top (volume per mA decreases as level approaches 20mA)
PLC thus should convert level (mA) to volume from 4 to 11.0 mA linearly as :-

Volume = Offset Volume+Change of Volume per mA x (measured mA - 4)

However, as soon as non-linear range starts (11.0mA) PLC should begin level to volume conversion differently.

The tank now should be strapped into a number of small zones (of level) where volume within each zone could be safely considered linear. Then as long as level stays between those individual straps, volume can be calculated as

Volume = Previous Volume + (difference of volume / difference of mA) x (measured mA - 4)

Previous level is volume measured before existing strap
Difference of volume is Maximum Volume - Min Volume within the strap
Difference of mA is Maximum mA - Min mA within the strap
Measured mA is mA just received by PLC

For example shown above, Volume of tank at various mA is:

```
= 14L+(28L/7mA)   x(measured mA-4) if measured mA is between 4.0mA & 11.0mA
= 42L+(12L/2.25mA)x(measured mA-4) if measured mA is between 11.0mA & 13.25mA
= 54L+(10L/2.25mA)x(measured mA-4) if measured mA is between 13.25mA & 15.5mA
= 64L+(8L/2.25mA) x(measured mA-4) if measured mA is between 15.5mA & 17.75mA
= 72L+(6L/2.25mA) x(measured mA-4) if measured mA is between 17.75mA & 20.0mA
```

Volume at various strapping level can be found by taking notes of amount of fluid needed to raise the level, or it can be calculated mathematically from tank dimensions.

Also, the more the number of straps the better the approximation is.

Caution :- Devices that work on capacitance principle for measurement of level of fluids, are for indicative purpose only. These devices should never be used for inventory control, weights and measures or any other place where highly accurate measurement of fluid level/volume/weight etc is needed.

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